A projection of China's health expenditures from today to 2050

Yinhe Li

Master thesis

Institute of Health Management and Health Economics

UNIVERSITY OF OSLO

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1. Introduction

Currently China is experiencing the historic demographic transition as other developed and developing countries in our world. The average age of Population rapidly increased from 26.1 years old in 1980 to 32.9 years old in 2005 (United Nations, 2006). Furthermore, due to the inception of “One Child Policy” in 1979, Chinese society already lost 250 millions young individuals during the last decades (Mcloughlin, 2005, p. 310). Consequently, the population would become elderly more quickly than the natural transition.

Age has been widely considered as one of principal factors determining the nature and extent of an individual’s demand for health services. Some cross-sectional data already indicated that, with the increases of age the demand for healthcare services rises steeply; and the healthcare expenditures of older age groups are considerably higher than the remainder of the population (OECD, 1988, pp. 27-33).

Therefore, we can expect that with the dramatic increases of age population and relative shrinkages of working populations, the ageing issue would significantly challenge Chinese society’s capability to deal with the age wave in health care sector.

Unfortunately, “China is poorly prepared to care for a rapidly increasing elderly population, and the time to address the challenge is running dangerously short” (Jackson & Howe, 2004, p. 13). And few analysis and projections were conducted on the future healthcare-expenditures. Due to the lacuna of this field, the health authority may lack the scientific fundament to adopt suitable long-term health policies for population ageing. Therefore, the proper projections of future health expenditures from the perspective of population ageing are quite urgent and necessary.

In an attempt to fill the lacuna in this area, we quantitatively analyzed the mechanism of population ageing on China’s health expenditures, and projected the future trends of health spending caused by pure ageing effects in this study.

In order to address the potential impacts of the population ageing on health expenditures, the projection methodology adopted by the Canadian Institute for Health Information (CIHI 2005) and OECD (1988) was applied in this study. Namely, we regarded the total health expenditures in each particular year as the aggregate of the health expenditures consumed by

each age group. The health expenditures in each age group for a particular year were estimated by multiplying per capita health spending in the age group and the number of persons in the age group.

Furthermore, for the projection of total health expenditures, the values of per capita health expenditures in each age-group and the populations in each age-group in each year are required. Fortunately, two internationally reputable institutions—Population Division of United Nations and American Census Bureau have presented quite comprehensive projections of China's population to 2050. Thus, we basically concentrated on the addressing of per capita health expenditures in each age group.

Since China currently lacks the data of per capita health expenditure by age groups, we developed several simulation models of per capita health expenditures in each age group based on empirical evidences from China and other countries. And then the most preferred simulation-models were selected into the projecting of future health expenditures.

Through our studies on the population ageing and health expenditure, we discovered several meaningful findings which may enable us to better understand the mechanism of the ageing effects on health expenditures and the future trends of China's health expenditures.

Firstly, we discovered that the trends of per capita health expenditures by age groups in studied developed countries were remarkably similar, although the data of per capita health expenditures was collected at various points of times from four different countries.

Secondly, according to several results of simulation models, we concluded that China's incidences of chronic diseases can largely explain the historical out-of-pocket health expenditure during 1995-2005. Or in other words, we found new evidences which are able to justify the statement of World Bank that China's "chronic diseases already account for the majority of hospital services and health care costs" (World Bank, 1992, p. 12) in the context of out-of-pocket health expenditures.

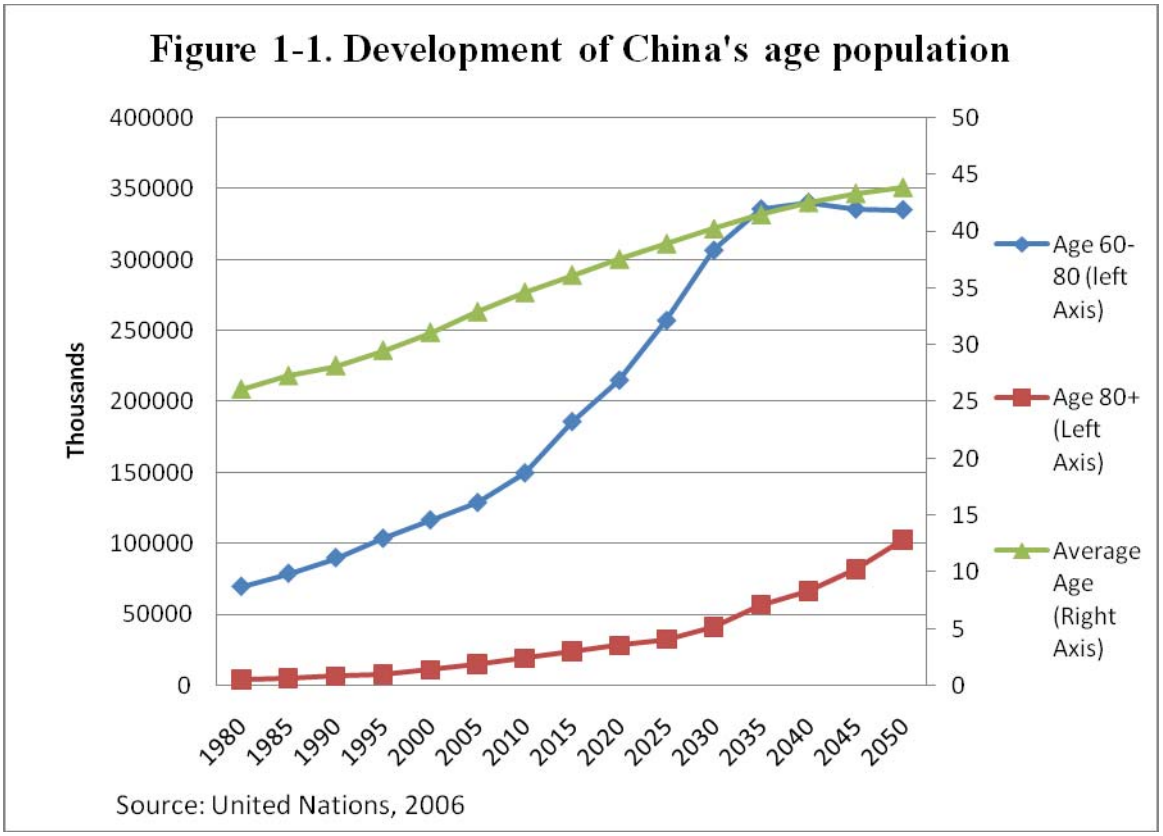
Finally, according to our estimates, the ageing effects will continually enhance its impacts on total health expenditures and come in full force during 2035s-2040s. Thereafter, such effects will be gradually moderated. As a whole, by 2050s the population ageing will solely drive the Total health expenditure rise almost twice as the total health expenditures in year 2005.

Meanwhile, since the population ageing will enforce its impacts on the Out-of-pocket health expenditures by a different mechanism compared with Total health expenditures, the ageing effects on the out-of-pocket health expenditures will appear earlier and more significantly.

2. Background

2.1 China's population ageing

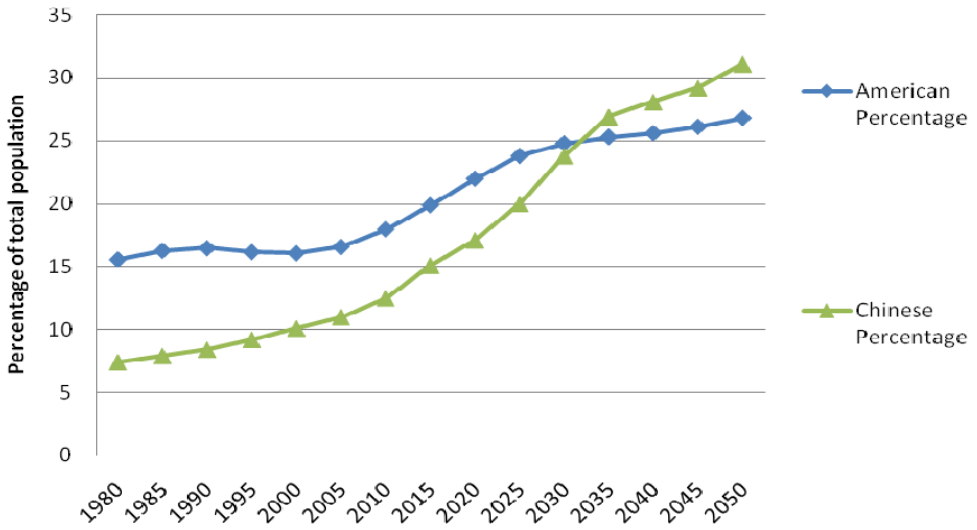
Currently China is experiencing the historic demographic transition as other developed and developing countries in our world. According to the data from United Nations, China's average age will increase rapidly from 26.1 years old in 1980 to 40.22 years old in 2030, and 43.86 years old in 2050. The populations of age group 60-80 and the age group older than 80 years also will leap from 69.5 millions and 4.33 millions in 1980 to 334.8 millions and 103 millions in 2050 respectively. (United Nations, 2006)



The serious challenge of China's population ageing is partially caused by China's "One Child Policy". Since its inception in 1979, Chinese society already lost 250 millions young individuals during the last decades (Mcloughlin, 2005, p.310). Consequently, the China's population will become elderly more quickly than the natural transition.

This artificially accelerated ageing development is quite obvious in the below comparison between Chinese and American population from 1980 to 2050. The proportion of China's elderly (Aged 60 and over) will sharply rise from 7.4% in 1980 to 31.1% in 2050 due to the artificial intervention on Chinese fertilities. Meanwhile, United States will follow the natural transition. The proportion of American elderly (Aged 60 and over) will gradually rise from 15.6% in 1980 to 26.8% in 2050. In these 70 years, the proportion of China's elderly age 60 and over will dramatically increase by 24%, but this growth will be only 9% in United States (United Nations, 2006).

Figure 1-2. Elderly (Aged 60 & over) as the percentage of American and Chinese total Population (1980-2050)



Source: 1. United Nations, 2006
2. Jackson & Howe, 2004, p. 3

The ageing developments are largely determined by past fertility and mortality rates. Even if Chinese authority decides to loosen its "One child policy" by the increasing pressures of its population ageing in the following years, of course the released fertility may progressively change the overall age structure of China's population. But, the passage into old age of the large number of people born between the 1950s and mid-1980s (United Nations, 2006) will still lead to a tight pressure on China's health expenditure budgets in spite of the potential abandonment of "One Child policy" (OECD, 1998, p. 26).

2.2 The challenge of gradual population ageing

The population ageing is a gradual process, and the negative influences of ageing will also appear gradually. But this slow speed is exactly the key danger of population ageing: when government and public totally understand the harms of the problem, we have already passed the best point of time to address and reduce it. Therefore, we think that it is urgent and necessary to analyze the mechanism of aging effects on China's health expenditures, and properly project China's health expenditures caused by ageing developments immediately. Quicker responses on this ageing issue will earn more precious time for China's health authority to adopt proper health policy to release the negative impacts of population ageing.

2.3 Finance system in China's healthcare sector

China's public health insurance system consists of three major schemes, and the citizens pay health service fees according to the health insurance scheme they are belonging to.

The first scheme is the Government Insurance Scheme (GIS), which is a unique and stable public medical system for employees of the Government and State institutions, under which medical costs were covered by government budgetary allocation (Liu, 2002, p. 134). According to the related data, only 20.95 millions privileged Chinese (1.62% of the population) were covered by this health insurance scheme in 2003 (National Research on Health Services, 2004 & China Statistical Yearbook, 2004).

The second major scheme is the Labour Insurance Scheme (LIS), which is "a work unit-based self-insurance system that bore all costs of medical treatment, medicine and hospitalization" (Liu, 2002, p.143). The employees of state owned and collective enterprises are the beneficiaries of this scheme. The China's government requires that state owned enterprises with more than 100 employees must provide Labour Insurance Scheme for their employees (Wong & Gabriel, 1998).

Historically, 201 million persons, nearly 44.3% of the urban population, were insured by this type of insurance in 1989. However, since "many enterprises earned no profit and approximately one-third of the state enterprises ran at a deficit" (Hsiao, 1995, pp. 1049-1050), many states owned enterprises were allowed to release their obligations of labour insurances for their workers. Consequently, the percentages of urban residents with LIS

sharply declined from 44.3% in 1989 to 30.2% in 2003 (National Research on Health Services, 2004).

The third insurance scheme is the “Rural Cooperative Medical System” (RCMS), which once universally provided low-cost basic health care for most rural residents. “At its peak effectiveness, 90% of the Chinese rural population was covered by the system.” Nevertheless, due to the economic reform of the agricultural sector in 1981 and the Medical Reforms initiated around 1986, the RCMS has nearly collapsed (Hsiao, 1995, p. 1050). By 2003, only 9.5% of rural residents were still maintaining in the Rural Cooperative Medical System (National Research on Health Services, 2004).
Even including commercial health insurances, only 55.2% of urban residents and 20.9% of rural residents, or 35% of the total population, had some kind of health insurance in 2003 (National Research on Health Services, 2004).

Under such poor coverage of health insurances, the majority of Chinese people are still short of basic healthcare services and actually lack the capability to deal with serious diseases. According to data from the Third National Health Survey, 35.7% of Chinese patients chose self-treatments for their diseases; and 13.1% of patients even did not adopt any medical treatments when they were suffering diseases. More seriously, due to the poor financial supports for Chinese patients, the serious diseases have been major causations for Chinese poverty. As shown in some studies, “30% of the people who live below the poverty line became poor because of the financial losses incurred during serious illness” (Hsiao, 1995, p.1053).

Furthermore, we can expect that, with the rapid developments of China’s population ageing, more and more Chinese people will enter the vulnerable populations for illness in the coming decades. Consequently, more Chinese patients will be kept out of basic healthcare services due to the poor effectiveness of health insurance.

3. Projection of health expenditures

Although numerous approaches are available to project China's health expenditures in theory, few approaches actually are suitable when these approaches are applied in China's circumstances. Therefore, we carefully analyzed the strengths and weakness of the potential approaches, and finally selected the approach used by CIHI and OECD as our main methodology.

In the CIHI study—"Provincial and Territorial Government Health Expenditure by Age Group, Sex and Major Category: Recent and Future Growth Rates, 2005" and the OECD study—"Ageing Populations, The Social Policy Implications, 1988", the projections of future health expenditures were developed by combining the present per capita expenditures for each age groups with the projected population in that age group each year (OECD, 1988, p. 35 & CIHI, 2005, p.4).

This approach also can be expressed by the following mathematical equation:

$$(1) H(t) = \sum_a E_a N_a(t)$$

Where $H(t)$ is total health spending in year *t*, E_a is the average per-capita health spending in age-group *a*, and $N_a(t)$ is the total number of individuals in age-group *a* in year *t*.

Notably, in this approach the "per capita within a given age group will remain constant over the projection period" (CIHI, 2005, p.1). Namely, the per capita health spending within a given age group is not subject to time.

As shown in the above equation, this approach tries to project the future health expenditures by concentrating on the changes of E_a and $N_a(t)$. If we further introduce our assumption that E_a will keep constant in the whole studied period, then the projections based on this approach will exclusively concentrate on the changes of populations in each age group. In case of China's population ageing, the adoption of this approach would enable us to better capture the impacts of population ageing on health expenditures.

Furthermore, thanks to the comprehensive data of China's $N_a(t)$ offered by American Census Bureau and the solid empirical data of China's E_a, we were able to enjoy a fairly good feasibility to project China's health expenditures by using this approach.

Alternative approaches:

Instead of the methodology adopted by our studies, several alternative approaches could have been available in theory. One example is the Culter-Sheiner approach:

$$MedicalSpending(t) = \sum_a m_a(t) * h_a(t) * N_a(t)$$

Where $N_a(t)$ is the number of people in age group *a* in year *t*, $h_a(t)$ is the average health status of people in age group *a* in year *t*, and $m_a(t)$ is average medical spending conditional on health status. The health expenditures was forecasted by capturing the trends of several key factors related with health expenditures, such as disability rate, proximity to death, unit medical spending conditional on health status, and projected populations in each age group (Cutler & Sheiner, 1998, p. 5).

Obviously, the Culter-Sheiner approach may capture the future health-expenditures more precisely than our method. Nevertheless, as a developing country, the expensive measurements of data such as disability rate, proximity to death, and the unit medical spending conditional on health status are largely absent in China. Thus, the Cutler & Sheiner approach is unfeasible for our purpose.

The regression approaches also are the common methods, which were widely applied in the projections of various issues. This kind of approaches can capture the tendency of studied subjects by "exponential smoothing and regressions on historical data" (Mahal & Berman, 2001, p.25) and further conduct projections based on the captured trend.

However, due to the poor registrations of health-related data, China has not accumulated enough related health data for many years, and providing a solid data-fundament for the regression and projection on China's health-expenditures.

Furthermore, basically the regression approach tends to conduct projections based on the trend simulated by historical data. But in the case of China's population ageing, which will typically follow a long-term cyclical trend instead of historical trend because of "One child Policy". Namely, when the Chinese people born in baby boom pass away naturally during 2030s--2050s, China's age structure will return to a typically natural age structure after 2050s. And consequently, the ageing effects on health expenditures also will be significantly slowed down after the peak of ageing, instead of a straight growth. In this sense, the regression approaches "are likely to be more effective for short-term forecasts than being able to take account of the dynamics that the process of (China's) ageing is typically associated with" (Mahal & Berman, 2001, p. 25).

4. Projection of China's Health Expenditures to 2050

4.1 Main projection methodology

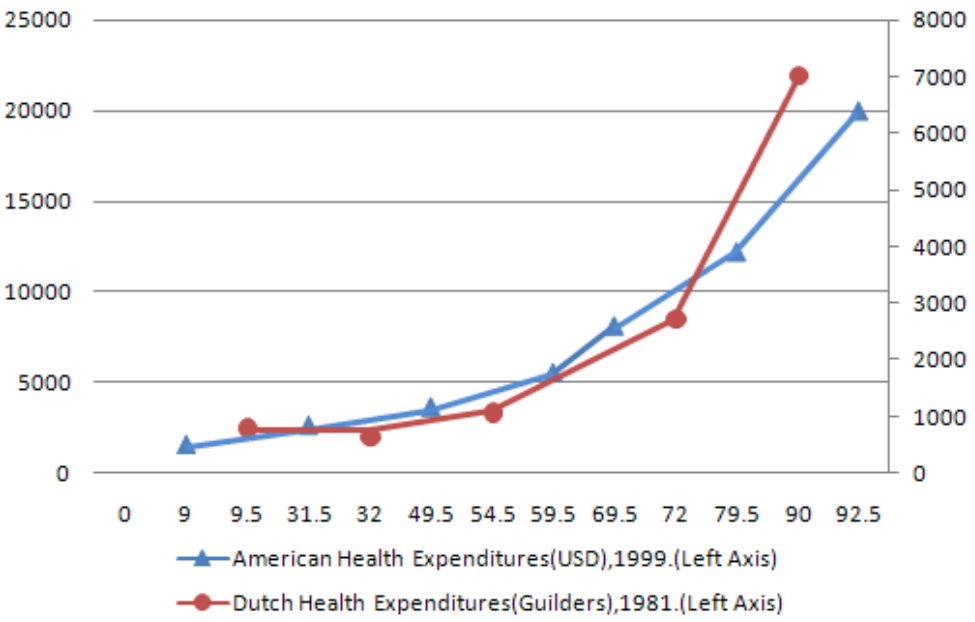
The main methodology adopted by CIHI (2005) and OECD (1988) was applied in this study, namely, the previously mentioned equation (1). In order to project China's health expenditures, $H(t)$, for each year to 2050, two variables must be obtained: total number of individuals in age-groups for each year $N_a(t)$, and per capita health-spending by age groups E_a. Since $N_a(t)$ have been comprehensively presented by some international reputed institutions, we basically concentrated on the addressing and simulating of E_a. Consequently, we developed several simulation models of China's E_a, which are based on some empirical evidences and statements from several reputable organizations.

4.2 E_a based on empirical evidences from developed countries

As OECD stated in year 1988, age has been widely considered as one of principal factors determining the nature and extent of an individual's demand; and healthcare expenditures of older persons are considerably higher than that of the remainder of the population. (OECD, 1988, pp. 27-33)

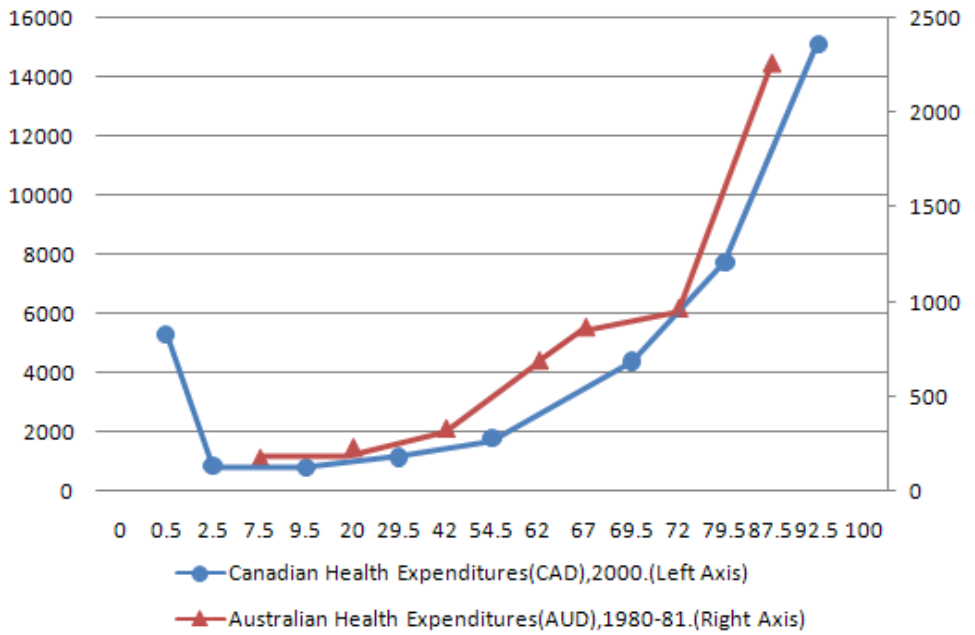
Actually, this statement was strongly supported by many solid empirical evidences throughout our world. As shown in Figures 4-1 and Figure 4-2, the main tendency of per capita health expenditures in each age group were remarkably similar, although these data of per capita health expenditures were collected at various points of time during 1981-2000 from different developed countries, where the economic conditions, health systems and social cultures were substantially diverse. Or in other words, the per capita health expenditures tended to rise sharply with the growth of age in all these countries.

Figure 4-1. American and Ducth health expenditures by age groups



Sources: 1. Keehan et al, 2004
2. Social and Cultural Planning Office, 1984

Figure 4-2. Canadian and Australian health expenditures by age groups



Sources: 1. CIHI, 2005
2. Social Welfare Policy Secretariat, 1984

Furthermore, since “China's pattern of diseases and death had become very much like that of the industrialized world” (World Bank, 1992, p.1), we probably can expect that China’s E_a may follow the similar tendency of E_a widely appeared in developed countries. Therefore, we decided to adopt observed values of E_a from selected developed countries as proxies for China’s E_a.

Canadian studies provided the most comprehensive data of per capita health spending by age groups, especially for the E_a data among infant age groups. Thus, the Canadian E_a was finally chosen as the proxy for China’s E_a.

Moreover, we are trying to obtain the tendency of China’s E_a by simulating Canadian E_a instead of analyzing the real health spending consumed by each Canadian age group. We considered the Canadian dollars consumed by age groups as the “measurement units” instead of real currency. Then, the only difference between Canadian E_a and China’s E_a is the “units” consumed by each age group. And the relationship of Canadian E_a and China’s E_a can be presented as the following mathematic expression:

$$(2) \quad E_{a,China} = E_{a,Canada} * R_{Canada}$$

Where $E_{a,Canada}$ is the Canadian per capita health spending by age groups, $E_{a,China}$ is the China’s per capita health spending by age groups and R_{Canada} is the constant ratio between China’s E_a and Canadian E_a in each age group.

This R_{Canada} can be interpreted as a combination of exchange rate between Canadian currency and Chinese currency, the different utilization rates of healthcare services between Canadian and Chinese citizens, Inflation rate and so on.

Furthermore, according to the main methodology of this study—equation (1), China’s health expenditures can be expressed as the follows:

$$(3) \quad H(t)_{China} = \sum_a E_{a,China} N_a(t)_{China}$$

By inserting the equation (2) into above equation (3), we obtained:

$$(4)\quad H(t)_{China} = \sum_a E_{a,Canada} * R_{Canada} * N_a(t)_{China} = R_{Canada} \sum_a E_{a,Canada} * N_a(t)_{China}$$

In the latter equation, only R_{Canada} is unknown. Therefore, the R_{Canada} can be obtained when the values of known variables were inserted into this model.

Notably, in order to obtain specific values of $H(t)_{China}$ and $N_a(t)_{China}$, we further assumed that the changes of China's historical health expenditures during 1995-2005 can be totally explained by population developments and keeping the impacts of other related factors constant. Or in other words, no matter which year was selected to provide data of $H(t)_{China}$ and $N_a(t)_{China}$, the results of R_{Canada} are same. Then we simply chose the middle year of the historical years, namely year 2000 as the base year. We further adopted the historical values of $H(t)_{China}$ and $N_a(t)_{China}$ in years 2000 as base values to calculate the China's E_a.

Then the estimated value of $\hat{R}_{canada}$ is 0.1168 for the year 2000. The value of China's $\hat{E}_a$ was obtained by multiplying $\hat{R}_{canada}$ with Canadian E_a, confer Table 4-1.

Table 4-1. Estimated *Ea* based on Canadian *Ea*

Age group	Canadian *Ea* in year 2000(1997 Price)	China's *Na(t)*, population by age groups,Millions (Year 2000)	Estimated Total Health-Spending by each age group (Billions)	Estimated China's *Ea* based on Canadian Ea (Yuan)
<1	5300.80	17.71	93.89*R	619.04
1--4	835.70	76.76	64.15*R	97.60
5--14	783.90	228.60	179.20*R	91.55
15-44	1121.70	626.57	702.82*R	131.00
45-64	1763.20	231.67	408.49*R	205.91
65-74	4369.40	59.69	260.81*R	510.27
75-84	7731.80	23.75	183.59*R	902.94
85+	15108.30	4.10	61.99*R	1764.39
Total		1268.87 Millions	1954.94*R	

China's Real Total health expenditures is 228.3 billions Yuan in 2000 (1 US Dollar=8.28 Yuan)
R=0.1168

Sources:
1.CIHI, 2005
2. Chow, 2006
3. Health Ministry of China, 2007
4. China Statistical YearBook 2004-2006
5. U.S. Census Bureau, 2008

4.3 E_a based on empirical evidences from inside China

4.3.1 Simulation model of E_a based on the Incidences of Chronic Diseases

According to the World Bank, "(China's) heart diseases, chronic obstructive lung disease, stroke, cancer, injuries and suicide are the leading causes of mortality, accounting for 72% of all deaths; these same chronic diseases already account for the majority of hospital services and health care costs" (World Bank, 1992, p. 12). In other words, the health expenditures for chronic disease can largely represent China's total health expenditures. If we further assume that the cost of each chronic disease is equal across all age groups, then the incidences of chronic disease in a given age group may be able to represent the health expenditures, and also explain the tendency of per capita health expenditures for this age group.

By following this idea, we developed a new simulation model for E_a, where the tendency of the incidences of chronic diseases presented by "National Researches on Health Services, 2003" was adopted as the new proxy for China's actual E_a.

Since we are trying to address the tendency of E_a by simulating the tendency of chronic diseases, instead of ascertaining real chronic diseases suffered by each age group, we considered the incidences of chronic diseases suffered by each age group as a "measurement unit" instead of chronic diseases. Then we obtained a following mathematic equation:

$$(5) \quad E_{a,China} = I_{Chronic,China} * R_{Chronic}$$

Where $E_{a,China}$ is the China's per capita health spending by age groups, $I_{Chronic,China}$ is the incidences of chronic diseases by age groups, and $R_{Chronic}$ is the constant ratio between actual E_a and the chronic diseases incidence in all age groups.

Furthermore, according to the equation (3) and the new equation (5), the health expenditures can be expressed as the following way:

$$(6) \quad H(t)_{China} = \sum_a I_{Chronic,China} * R_{Chronic} * N_a(t)_{China}$$

In above equation (6), $H(t)_{China}$ $I_{Chronic,China}$ and $N_a(t)_{China}$ are known variables, and only $R_{Chronic}$ is unknown. Therefore, the $R_{Chronic}$ can be obtained, when the values of known variables were introduced into the model. The estimated value of $\hat{R}_{Chronic}$ was 1.4967 for the year 2000. Confer Table 4-2 for calculated values of $\hat{E}_a$.

Table 4-2. Estimated *Ea* Based on Incidences of Chronic Diseases

Age group	China's "Chronic Diseases Incidence in two week (‰)(Year 2003)"	China's *Na (t)*, population by age groups,Millions (Year 2000)	Estimated Total Health-Spending by each age group (Billions)	Estimated China's *Ea* based on Incidences of Chronic Diseases
0-4	6.26	94.48	0.59*R	9.36
5-14	9.56	228.6	2.18*R	14.30
15-24	17.96	198.6	3.57*R	26.89
25-34	58.31	243.28	14.18*R	87.27
35-44	117.09	184.69	21.63*R	175.25
45-54	219.52	144.98	31.82*R	328.55
55-64	362.14	86.7	31.4*R	542.01
65+	538.78	87.54	47.16*R	806.38
Total		1268.87 Millions	152.54*R	
China's Real Total health expenditures is 228.3 billions Yuan in Year 2000 R=1.4967				

Sources:
1.Health Ministry of China, 2007
2. U.S. Census Bureau, 2008
3. China Statistical YearBook 2004

4.3.2 Simulation model of E_a based on the Incidences of Diseases

As mentioned above, the World Bank stated that, "chronic diseases already account for the majority of hospital services and health care costs" (World Bank, 1992, p.12). Such statement may underestimate the health expenditures consumed by infants, and may ignore the health expenditures on acute diseases. Therefore, in a attempt to represent the more comprehensive picture of China's health expenditure, we adopted the data of diseases incidence in "National Research on Health Services, 2003" as the new proxy of the E_a. We further assumed that the cost of each disease is equal across age groups. Then the new equation of E_a and diseases incidence was developed as the follows:

$$(7)\quad E_{a,China} = I_{Diseases,China} * R_{Diseases}$$

Where $E_{a,China}$ is the China's per capita health spending by age groups, $I_{Diseases}$ is the incidences of diseases in two week (‰) by age groups, and $R_{Diseases}$ is the constant ratio between China's actual E_a and diseases incidences in all age groups.

Furthermore, according to the expression of China's health expenditures —equation (3) and the above equation (7), new relationship between health expenditures and incidences of diseases by age groups can be expressed as the following equation:

$$(8) \quad H(t)_{China} = \sum_a I_{Diseases,China} * R_{Diseases} * N_a(t)_{China}$$

Similarly, in this equation only $R_{Diseases}$ is unknown. Therefore, the $R_{Diseases}$ can be obtained, when the values of known variables were inserted into the model. The estimated value of $\hat{R}_{Diseases}$ was 1.4132 for the year 2000. Confer Table 4-3 for the estimated values of $\hat{E}_a$.

Table 4-3. Estimated *Ea* based on Incidences of Diseases

Age group	China's "Diseases Incidence in two week (‰)(Year 2003)"	China's *Na(t)*, population by age groups,Millions (Year 2000)	Estimated Total Health-Spending by each age group (Billions)	Estimated China's *Ea* based on Incidences of Diseases (Yuan)
0-4	133.00	94.48	12.56*R	187.95
5-14	72.21	228.6	16.51*R	102.04
15-24	49.83	198.6	9.9*R	70.42
25-34	82.48	243.28	20.07*R	116.56
35-44	126.21	184.69	23.31*R	178.36
45-54	191.53	144.98	27.77*R	270.68
55-64	251.77	86.7	21.83*R	355.81
65+	338.26	87.54	29.61*R	478.03
Total		1268.87 Millions	161.55*R	
China's Real Total health expenditures is 228.3 billions Yuan in Year 2000				
R=1.4132				

Sources:
1. Health Ministry of China, 2007
2. U.S. Census Bureau, 2008
3. Chow, 2006

4.4 Models of E_a tested by historical Total Health Expenditures

By following the widely appeared tendency and the authoritative statements from reputable international organizations, we developed several simulation models of E_a. However, since

these tendency and statements actually have not been carefully tested by empirical data; and the reliability of the simulation models of E_a would significantly influence the reliability of whole projections of future health expenditures, we decided to carefully check the accuracies of these models by applying the historical data of health-expenditures from year 1995 to 2005.

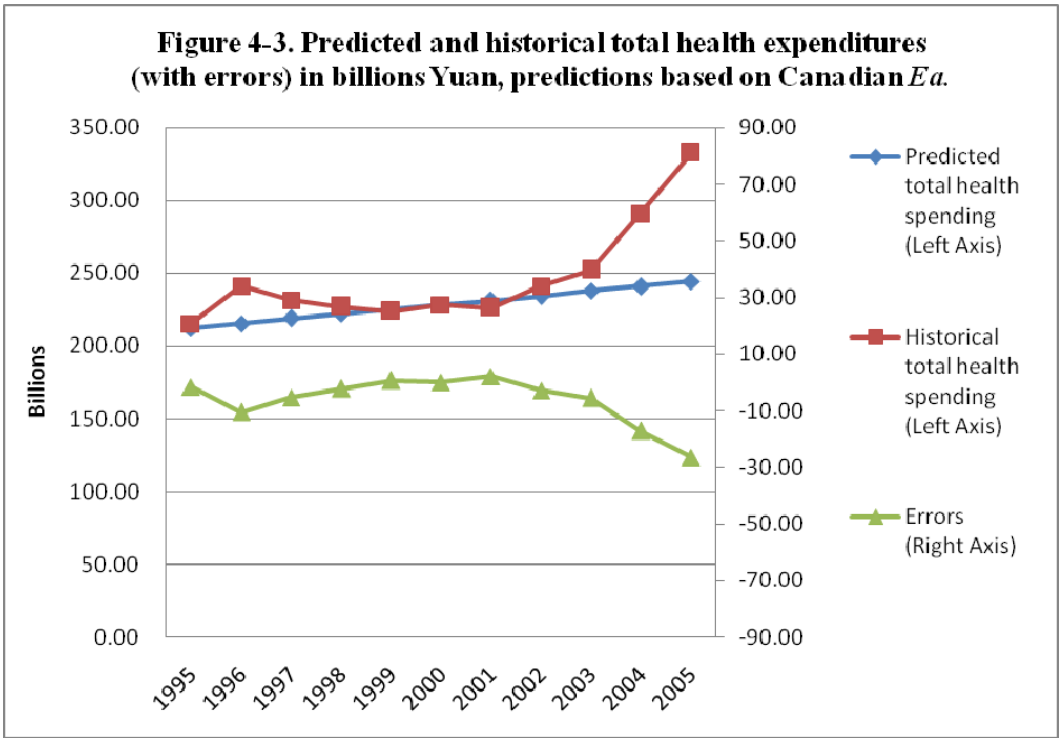
Furthermore, as we assumed that the changes of China's historical health expenditures during 1995-2005 were exclusively determined by population developments and keeping the impacts of other related factors constant. Then in theory when the simulated E_a was applied into each historical year with the historical $N_a(t)$, the errors between estimated health expenditures and historical health expenditures should be fairly small, if the simulated E_a is relatively accurate. In other words, the errors between estimated and historical health expenditures would be able to reflect the accuracies of these simulation models.

By following this thought, the obtained simulation models of E_a were tested by the historical data of health expenditures from year 1995 to 2005, only where the data of "Inflation index in health sectors" are available, which is the key data for calculating Real Total health expenditures and Real Out-of-pocket health expenditures.

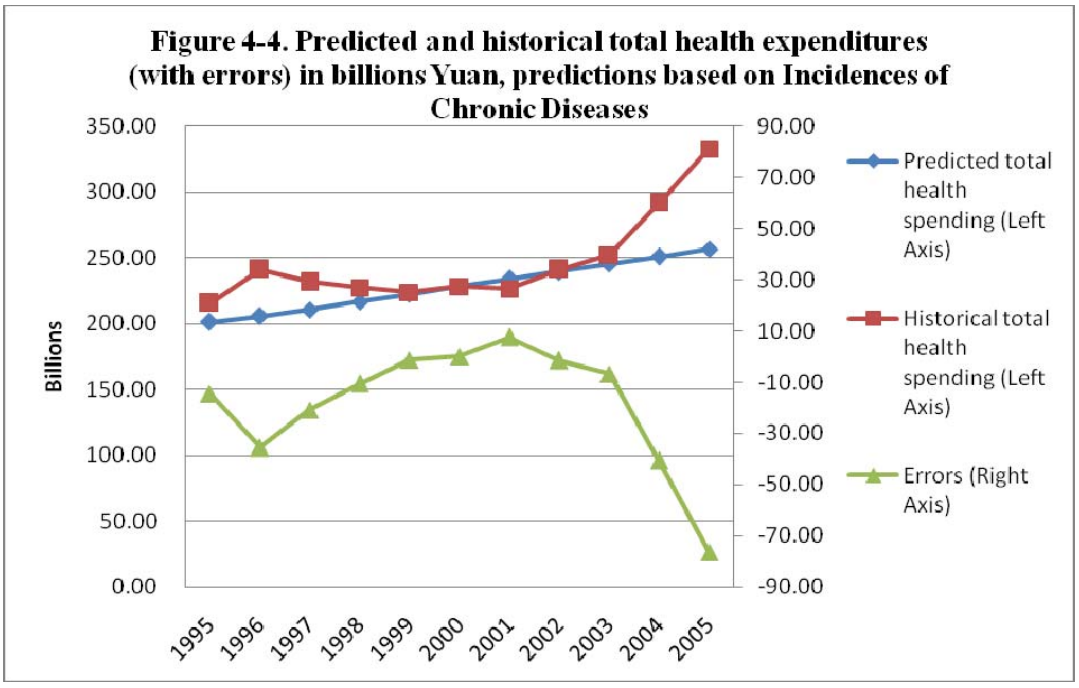
Moreover, the errors between estimated health expenditures and historical health expenditures were measured by two standardized instruments—"Average Errors (Absolute Value)" and "Average Differences by percentage (Absolute Value)".

Then the detailed accuracies of these simulation models were captured as the follows:

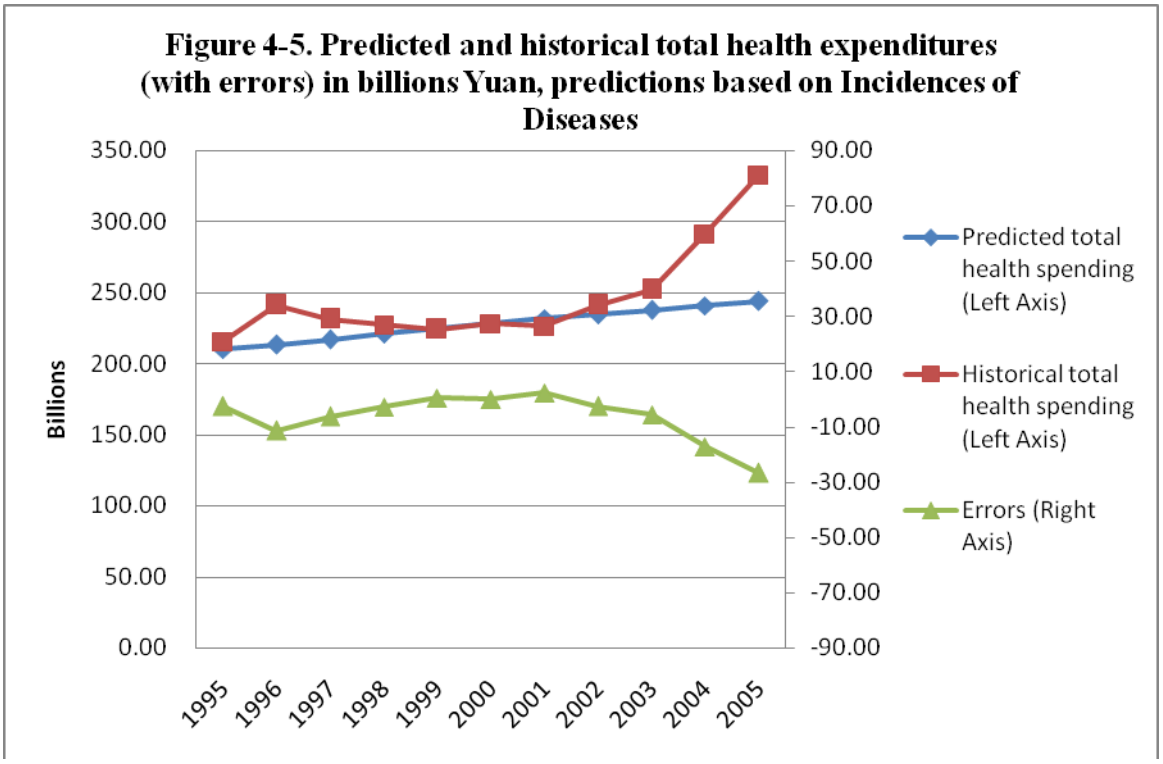
4.4.1 The model based on Canadian E_a tested by historical total health spending



4.4.2 The model based on incidences of Chronic Diseases tested by historical total health spending



4.4.3 The model based on incidences of Diseases tested by historical total health spending



The outcomes of above tests are suggesting that, the simulation model of E_a based on Canadian E_a appeared better preferences in the context of Total health expenditures, since its values of "Average Errors (Absolute Value)" and "Average Differences by percentage (Absolute Value)" are the smallest, only 19.24 billions and 6.78% correspondingly.

Based on this empirical finding, we may be able to conclude that China's per capita total health expenditures in each age group probably tended to follow the similar tendency of Canadian E_a rather than the tendencies of chronic diseases or diseases. In other words, China's E_a not only significantly skewed into age groups, but also substantially skewed to infant age groups as Canadian situation.

4.5 Models of E_a tested by historical Out-of-pocket Health Expenditures

As a developing country, China's government expenditures on health sectors sometime were largely decided by the fiscal pressures and political reasons instead of the actual medical

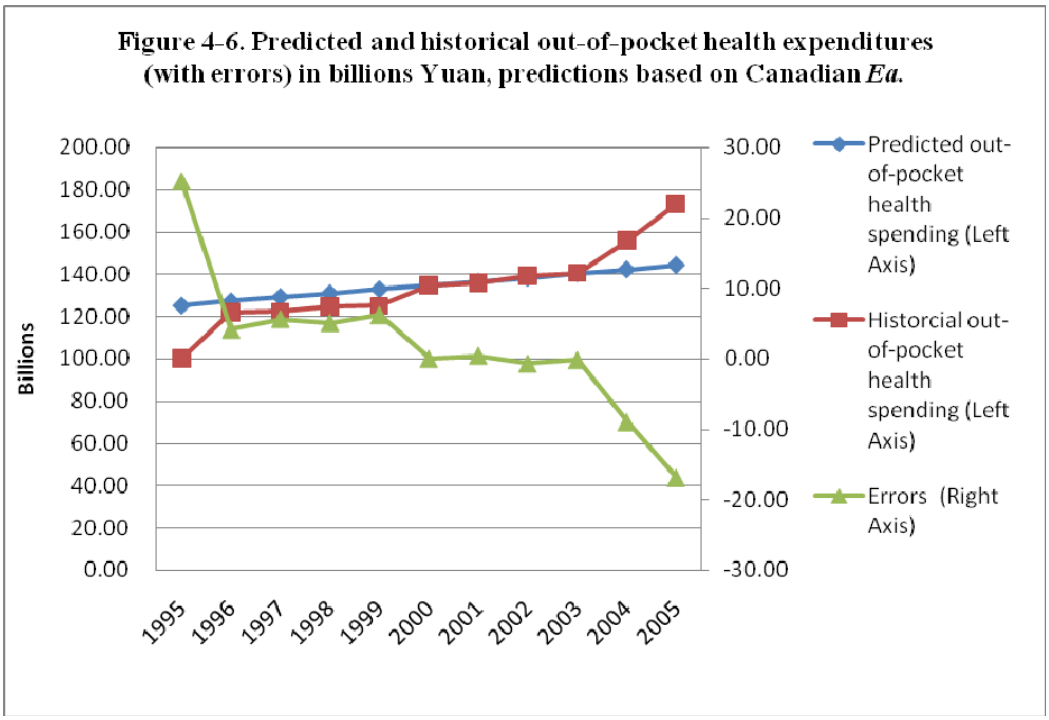
needs. For instance, in theory under the effects of the increasing GDP per capita, rising population and ongoing population ageing, the higher total health expenditures should be demanded by Chinese people. But the historical data of health spending actually revealed an inverse fact that, the real total health-expenditures declined by some extents during 1997-2001 despite increasing needs of health services from Chinese citizens.

In contrast, the out-of-pocket health expenditures may be more sensitive with the real needs of Chinese individuals, since the out-of-pocket health expenditures were fully controlled by them based on their real demands of health cares in spite of utilization rates or political reasons.

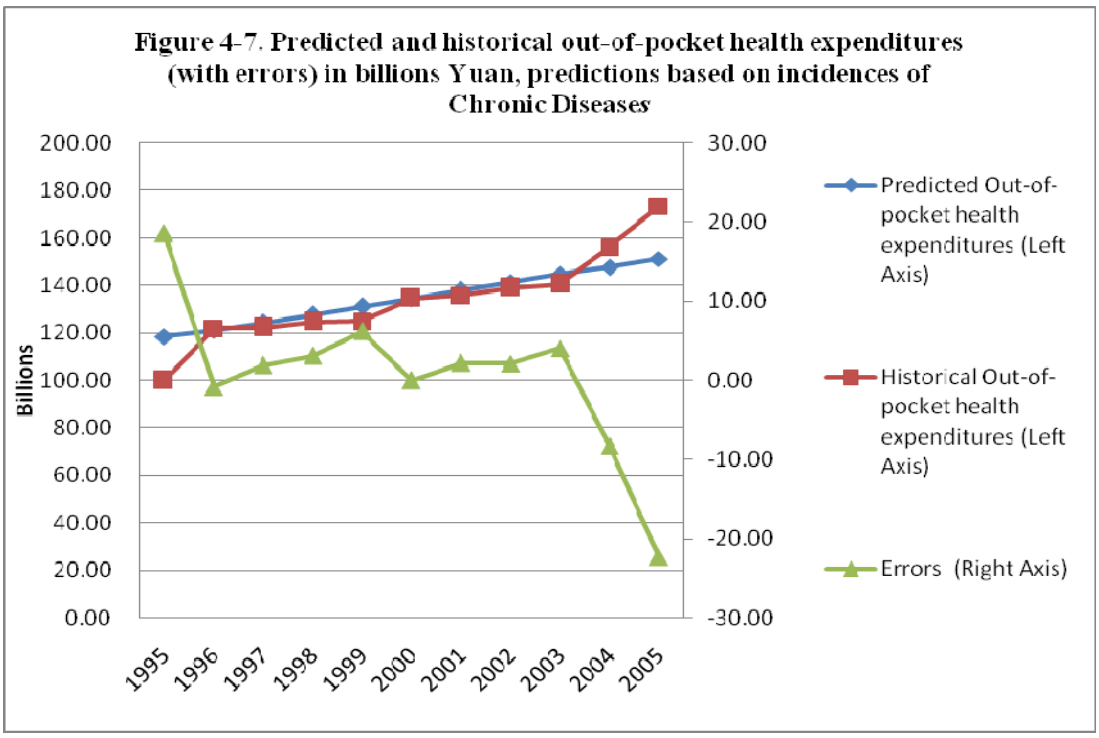
Therefore, we also employed the historical data of out-of-pocket health expenditures as the new instrument to check the accuracies of above simulation models in the same way as checking these models by historical total health expenditures. Then the detailed results are the follows:

4.5.1 The model based on Canadian *Ea* tested by historical out-of-pocket health spending

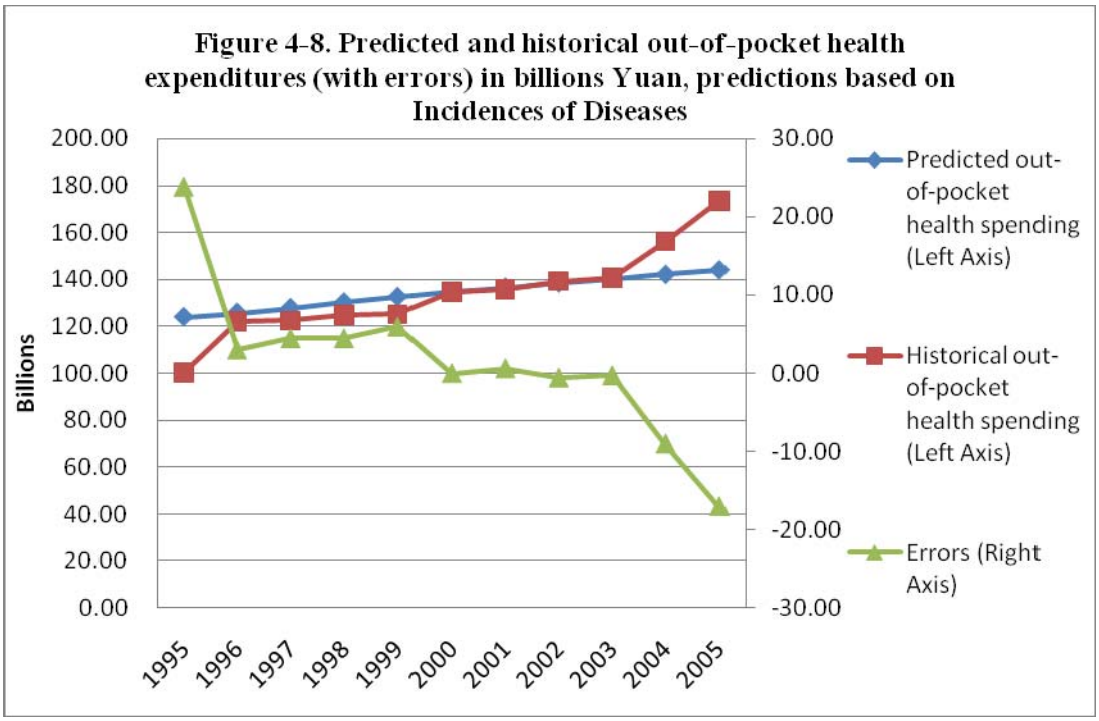
Figure 4-6. Predicted and historical out-of-pocket health expenditures (with errors) in billions Yuan, predictions based on Canadian *Ea*.



4.5.2 The model based on incidences of Chronic Diseases tested by historical out-of-pocket health spending



4.5.3 The model based on incidences of Diseases tested by historical out-of-pocket health spending



According to the results of above tests, the simulation model based on incidences of chronic diseases presented strong preferences in the context of Out-of-pocket health expenditures. Its values of "Average Errors (Absolute Value)" and "Average Differences by percentage (Absolute Value)" are remarkably small, only 6.33 billions and 4.77% respectively. It suggested that the trend of Chinese actual E_a was more close to the trend of chronic diseases rather than the trends of Canadian E_a or incidences of diseases in the context of out-of-pocket health expenditures.

This finding probably provided new empirical evidence which justified the statement of World Bank that, chronic diseases probably have accounted the majority of China's health expenditures (World Bank, 1992, p. 12) in the context of out-of-pocket health expenditures.

Moreover, due to this high proximity of chronic model and the actual E_a, we may also be able to suggest that Chinese out-of-pocket health expenditures were largely spent on elderly individuals, but quite few on young individuals.

4.6 Projected China's health expenditures to 2050

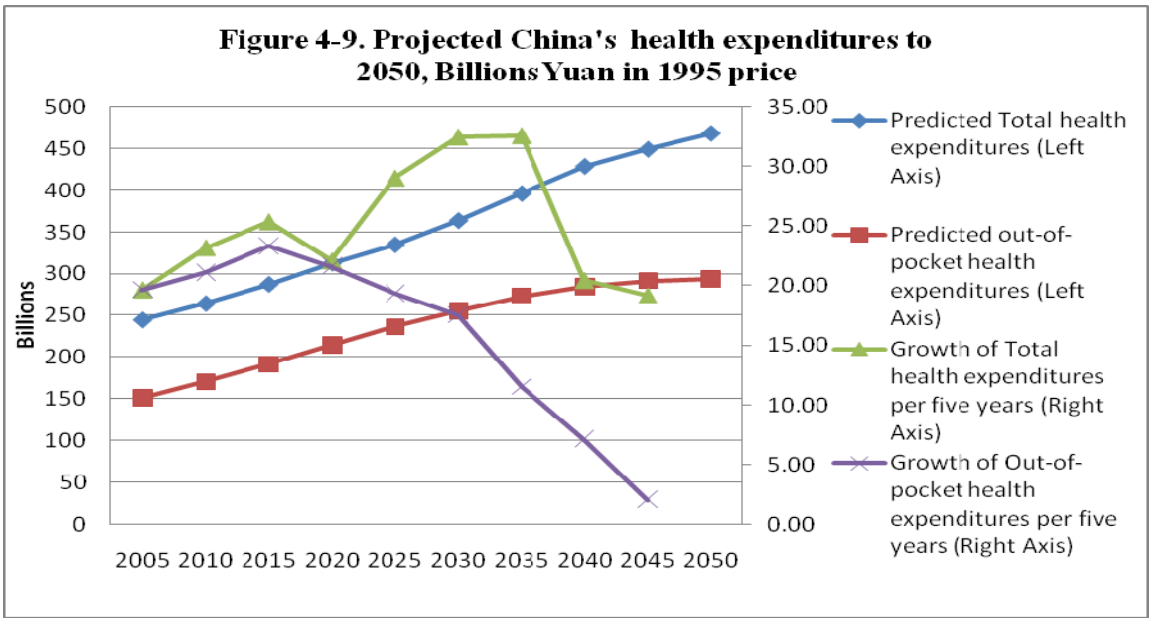
Since the model based on Canadian E_a and the simulation model of E_a based on the Incidences of Chronic Diseases (2003 Survey) have demonstrated their preferences in the contexts of total health expenditures and out-of-pocket health expenditures accordingly, we decided to project China's total health expenditures by the model based on Canadian E_a, and project the out-of-pocket health expenditures by the model based on incidences of chronic diseases respectively.

Besides the aggregate growths of health expenditures, we also estimated the potential marginal growths of health expenditures caused by population ageing—the "speed" of ageing effects on health spending, since the marginal growths will provide a clearer picture of ageing effects on health expenditures at every step.

By applying the preferred simulations models into the projections accordingly, the future health spending was calculated. Confer Table 4-10 for the detailed projections.

Table 4-10. Projected China's health expenditures to 2050

Year	Projected Total Health expenditures,Billions(1995 price)	Projected out-of-pocket Health expenditures, Billions(1995 price)	Marginal Growth of Total health expenditures per five years,Billions	Total Growth of total health expenditures (%) (Base Year 2005)	Marginal Growth of Out-of-pocket health expenditures per five years,Billions	Total Growth of out-of-pocket health expenditures (%) (Base Year 2005)
2005	244.52	151.18				
2010	264.17	170.85	19.64	108.03	19.67	113.01
2015	287.33	191.93	23.16	117.51	21.08	126.95
2020	312.67	215.25	25.34	127.87	23.32	142.38
2025	334.73	236.86	22.06	136.89	21.61	156.67
2030	363.74	256.20	29.01	148.76	19.34	169.47
2035	396.20	273.73	32.46	162.03	17.52	181.06
2040	428.77	285.26	32.57	175.35	11.53	188.68
2045	449.18	292.40	20.41	183.70	7.14	193.41
2050	468.32	294.43	19.14	191.52	2.03	194.75



The previous Table 4-10 and Figure 4-9 presents a full picture of China's future total health expenditures and out-of-pocket health expenditures. Or in other words, the ageing effects will continually enhance its impacts on total health expenditures and come in full force during 2035s-2040s, with 32 billions Yuan per five years. Thereafter, such effects will be gradually moderated. As a whole, by 2050s the population ageing will solely drive the Total health expenditure rise almost twice as the total health expenditures in year 2005.

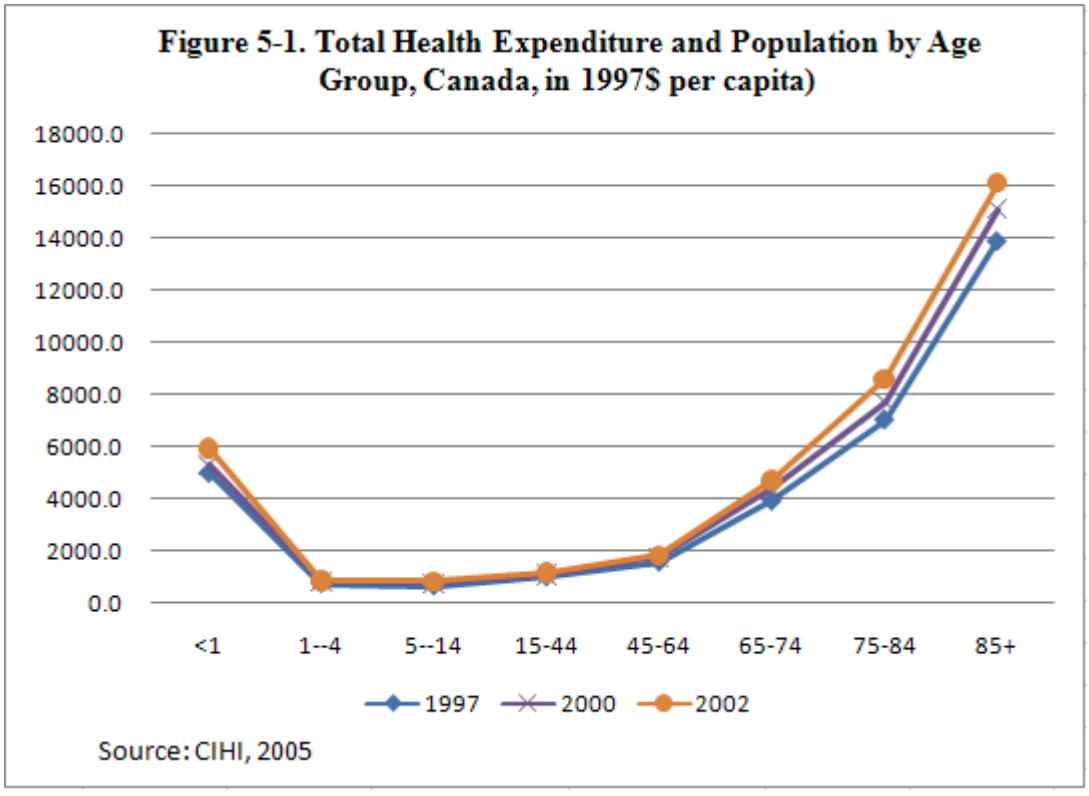
Meanwhile, the Out-of-pocket health expenditures will grow nearly twice as the health expenditures in year 2005 similarly. But notably, the ageing effects on China's out-of-pocket

health expenditures will appear more early and significantly. Namely, under the impacts of population ageing, the marginal growth of out-of-pocket health spending will quickly increase and reach to its maximum during 2015s at 23 billions Yuan. After that, the marginal growth of out-of-pocket health expenditures will be gradually moderated, and nearly ceased in 2050s.

5. Sensitivity Analysis

5.1 Will age-specific per capita health spending remain constant ?

According to some empirical evidences and lessons from developed countries, for instance, the Canadian evidences from 1997 to 2002—Figure 5-1, the Canadian per capita health spending in all age groups substantially increased during 1997-2002. In other words, the assumption of "per capita health spending within a given age group will remain constant over the projection period", probably will underestimate the future Canadian health-expenditures.



However, since the Canadian health system significantly varies from China's health system, it is uncertain whether China's per capita health spending in each age group will increase correspondingly. Since no related data is available to reflect such trend in China currently, we adopted the relatively conservative approach as CIHI, assumed that "per capita health spending within a given age group will remain constant over the projection period." (CIHI, 2005, p.1)

Nevertheless, we also can not exclude the probability that China's per capita health spending in each age groups may increase substantially with years as Canadian E_a. Especially, under the context of continually dramatic growths of China's economy, Chinese citizens probable will enjoy higher GDP per capita, higher health insurance coverage, and higher government investments on health sectors in future. Consequently Chinese people probably will consume higher per capita health expenditures in each age group even under the same population ageing transition. In this sense, our current projection which only concentrated on pure ageing effects, probably underestimated the future health-expenditures.

5.2 Choices of base year

In our current study, besides the assumption that the E_a will keep constant in the whole studied period, we also assumed that the changes of historical health expenditures during 1995-2005 were exclusively determined by population development and disregarded the impacts of other related factors. Then in theory no matter which year was selected to provide historical health expenditures for extracting China's E_a , the different choice will not raise any differences for E_a and further projections.

Under these assumptions, we simply chose the middle year of the historical years, namely year 2000 as the base year. And we further adopted the historical values of $H(t)_{China}$ and $N_a(t)_{China}$ in years 2000 as base values to calculate the E_a.

However, in reality the choice of base year may substantially influence the results of E_a and further affect the results of final projections, since the impacts of other related factors on historical health expenditures may not keep relatively constant as we assumed. For instance, the changing government's health policies, breakouts of epidemics, changing life styles, and even some random errors in the process of the data gathering, may substantially affected health expenditures besides population development.

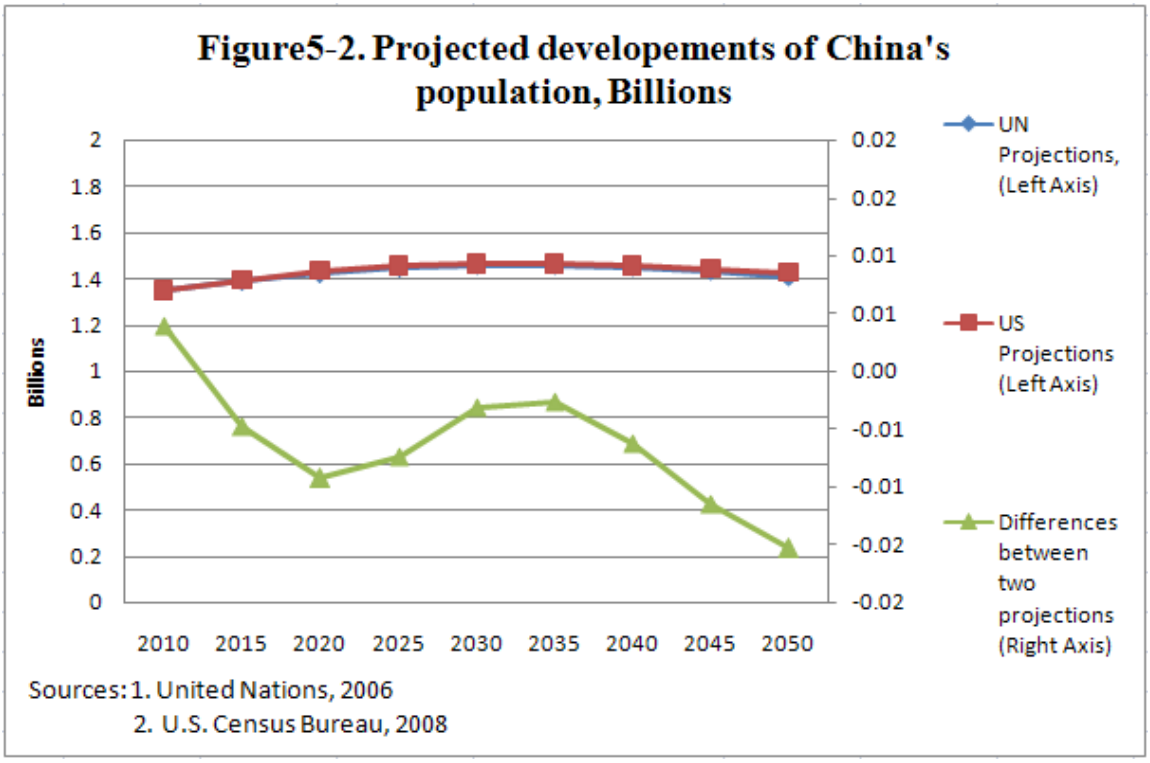
Therefore, no matter which year was chosen as base year, we can not exclude the probability that the changes of historical health expenditures were not influenced by the effects of other factors besides population development. We also should admit that the different choices of base year may substantially shape different results of E_a and final projections.

5.3 Reliability of projected population developments

Under our current methodology, two key data are required for the projections of China's health expenditures, namely, projected populations in each age group for each year to 2050, and the per capita health expenditures by each age group.

Fortunately, several international organizations already presented the projections of China's populations in each age group to 2050 with very high authorities. The projected populations offered by American Census Bureau is the most comprehensive among these projections, providing the most detailed projection of China's population in each year. Therefore, we applied the population projections provided by American Census Bureau for the projections of health expenditures in this study.

However, since the reliability of projected populations will largely influence the reliability of whole projections of health expenditures, we decided to apply the projected data from the Population Division of United Nations to check the reliability of U.S. projections. Confer figure 5-2 for the detailed results of this comparison.



According to the results of our estimates, the differences between UN projections and US projections seemed unsystematic and insignificant. These slight differences may be caused

by the different methodologies and data sources used to project China's population. Therefore, the decision of applying US data for the projections of China's health expenditures probably will not raise significant errors for our projections.

6. Conclusions

6.1 Remarkably similar tendencies of E_a in developed countries

Based on our analysis on the data of per capita health expenditures in United States, Canada, The Netherlands, and Australia, we discovered that the main trends of per capita health expenditures in these major developed countries were remarkably similar, although these data were collected at various points of time during 1981-2000 from different developed countries, where the economic conditions, health systems and cultures were substantially diverse.

Therefore, we may be able to suggest that the main tendency of per capita health expenditures tended to be only sensitive with age, and relatively insensitive with time, social characteristics or economic conditions in developed countries.

6.2 High proximity of the model of E_a based on chronic diseases

When our predicted out-of-pocket health expenditures were compared with the historical data, the health expenditures predicted by the model based on chronic diseases appeared a strong proximity with historical health data. Its error is only 6.33 billions in term of absolute value; and 95.23 % of historical out-of-pocket health expenditures were explained by this model on average.

Therefore, there is one certain fact we can conclude that, the simulation model based on incidences of chronic diseases indeed outstandingly explained China's historical out-of-pocket health expenditures during 1995-2005, although we can not completely exclude the probability that this high degree of proximity may also be caused by other related factors simultaneously.

Furthermore, based on such high degree of proximity, we probably can suggest that the China's out-of-pocket health expenditure were largely spent on the treatments of chronic

diseases; and the elderly age groups consumed much more out-of-pocket health expenditures than the younger age groups.

6.3 Projected health expenditures

As we demonstrated in chapter 4, the population ageing will influence China's total and out-of-pocket health expenditures diversely, since their E_a tended to follow two different models, namely, Canadian model and chronic-diseases model respectively. Consequently, the total and out-of-pocket health expenditures actually will present two substantially different pictures of future tends even under same demographic transition.

For the total health expenditures, its marginal growth will continually increases and reach its peak during 2035s-2040s, with 32 billion Yuan per five years. Thereafter, such growth will be gradually moderated. As a whole, by 2050s China's total health expenditures will arise nearly twice as their figures in year 2005 under the ageing effects.

Meanwhile, under same impacts of population ageing, the Out-of-pocket health expenditures will grow nearly twice as the health expenditures in year 2005 similarly. But notably, the ageing effects on out-of-pocket health expenditures will appear earlier and more significantly. The marginal growths of out-of-pocket health spending will sharply increase in coming years and reach its peak during 2015s with 23 billions Yuan per five years. After that, ageing effects on out-of-pocket health expenditures will be gradually moderated, and nearly ceased in 2050s.

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Appendix A: The original data of the figures in this study

Table A-1. The original data of Figure 4-1

Table A-1.1. Per capita Health expenditure by age group: United States,1999(U.S. Dollars)

Age group	0--18	19-44	45-54	55-64	65-74	75-84	85+
Health Care	1,646	2,706	3,713	5,590	8,167	12,244	20,001

Source: Keehan et al, 2004

Table A-1.2. Per capita Health expenditure by age group: Netherlands,1981(Guilders)

Age group	0-19	20-44	45-64	65-79	80+
Health Care	790	640	1060	2710	7020

Source: Social and Cultural Planning Office, 1984

Table A-2. The original data of Figure 4-2

Table A-2.1. Total Health Expenditure and Population by Age Group, Both Sexes, Canada, Constant Dollars, 1997–2002 (in 1997$ per capita)

Age group	<1	1--4	5--14	15-44	45-64	65-74	75-84	85+
Health care	5300.8	835.7	783.9	1121.7	1763.2	4369.4	7731.8	15108.3

Source: CIHI, 2005

Table A-2.2. Per capita social expenditure by age group: Australia,1980-81(Dollars)

Age group	0-15	16-24	25-59	60-64	65-69	70-74	75+
Health Care	173	229	330	690	866	966	2262

Source: Social Welfare Policy Secretariat,1984

Appendix B: The related data in the accuracy tests of E_a

Table B-1. The data related with E_a tested by historical total health expenditures

Table B-1.1. *Ea* based on Canadian *Ea* tested by historical total health expenditures, Billions

Year	Predicted Total health spending	Historical Total health spending	Errors(Billions)	Differences between Predicted and Historical health spending(%)
1995	212.25	215.51	-3.27	-1.52
1996	215.58	241.05	-25.47	-10.57
1997	219.08	231.48	-12.40	-5.36
1998	222.10	227.22	-5.12	-2.25
1999	225.15	223.87	1.28	0.57
2000	228.30	228.30	0.00	0.00
2001	231.23	226.39	4.83	2.14
2002	234.31	241.05	-6.74	-2.79
2003	237.97	252.09	-14.12	-5.60
2004	241.01	291.23	-50.22	-17.25
2005	244.52	332.68	-88.16	-26.50
Average Errors			-18.12	
Average Errors (Absolute Value)			19.24	
Average Differences by percentage (Absolute Value)				6.78

Table B-1.2. *Ea* based on chronic diseases tested by historical total health expenditures, Billions

Year	Predicted Total health spending	Historical Total health spending	Errors(Billions)	Differences between Predicted and Historical health spending(%)
1995	201.06	215.51	-14.46	-6.71
1996	205.53	241.05	-35.52	-14.74
1997	210.61	231.48	-20.87	-9.01
1998	216.60	227.22	-10.62	-4.67
1999	222.50	223.87	-1.36	-0.61
2000	228.30	228.30	0.00	0.00
2001	233.90	226.39	7.51	3.32
2002	239.48	241.05	-1.57	-0.65
2003	245.30	252.09	-6.79	-2.70
2004	250.63	291.23	-40.60	-13.94
2005	256.33	332.68	-76.35	-22.95
Average Errors			-18.24	
Average Errors (Absolute Value)			19.60	
Average Differences by percentage (Absolute Value)				7.21

Table B-1.3. Ea based on incidences of diseases tested by historical total health expenditures, Billions

Year	Predicted Total health spending	Historical Total health spending	Errors(Billions)	Differences between Predicted and Historical health spending(%)
1995	210.08	215.51	-5.43	-2.52
1996	213.25	241.05	-27.80	-11.53
1997	216.66	231.48	-14.82	-6.40
1998	220.78	227.22	-6.44	-2.83
1999	224.65	223.87	0.79	0.35
2000	228.30	228.30	0.00	0.00
2001	231.62	226.39	5.22	2.31
2002	234.60	241.05	-6.45	-2.67
2003	237.81	252.09	-14.28	-5.66
2004	240.86	291.23	-50.37	-17.30
2005	244.07	332.68	-88.62	-26.64
Average Errors			-18.93	
Average Errors (Absolute Value)			20.02	
Average Differences by percentage (Absolute Value)				7.11

Table B-2. The data related with E_a tested by historical Out-of-pocket health expenditures

Table B-2.1. Ea based on Canadian Ea tested by historical Out-of-pocket health expenditures, Billions

Year	Predicted Out-of-pocket health spending	Historical Out-of-pocket health spending	Errors(Billions)	Differences between Predicted and Historical health spending(%)
1995	125.18	100.00	25.18	25.18
1996	127.15	122.08	5.07	4.15
1997	129.21	122.31	6.90	5.64
1998	131.00	124.62	6.37	5.11
1999	132.79	125.03	7.76	6.21
2000	134.65	134.65	0.00	0.00
2001	136.38	135.76	0.62	0.45
2002	138.20	139.14	-0.94	-0.68
2003	140.36	140.62	-0.27	-0.19
2004	142.14	156.10	-13.96	-8.94
2005	144.22	173.51	-29.30	-16.88
Average Errors			0.68	
Average Errors (Absolute Value)			8.76	
Average Differences by percentage (Absolute Value)				6.68

Table B-2.2. Ea based on chronic diseases tested by historical Out-of-pocket health expenditures, Billions

Year	Predicted Out-of-pocket health spending	Historical Out-of-pocket health spending	Errors(Billions)	Differences between Predicted and Historical health spending(%)
1995	118.58	100.00	18.58	18.58
1996	121.22	122.08	-0.86	-0.70
1997	124.22	122.31	1.91	1.56
1998	127.75	124.62	3.13	2.51
1999	131.23	125.03	6.20	4.96
2000	134.65	134.65	0.00	0.00
2001	137.95	135.76	2.19	1.62
2002	141.25	139.14	2.11	1.51
2003	144.67	140.62	4.05	2.88
2004	147.82	156.10	-8.28	-5.30
2005	151.18	173.51	-22.33	-12.87
Average Errors			0.61	
Average Errors (Absolute Value)			6.33	
Average errors by percentage (Absolute Value)				4.77

Table B-2.3. Ea based on incidences of diseases tested by historical Out-of-pocket health expenditures, Billions

Year	Predicted Out-of-pocket health spending	Historical Out-of-pocket health spending	Errors(Billions)	Differences between Predicted and Historical health spending(%)
1995	123.91	100.00	23.91	23.91
1996	125.77	122.08	3.70	3.03
1997	127.78	122.31	5.47	4.48
1998	130.22	124.62	5.60	4.49
1999	132.50	125.03	7.47	5.97
2000	134.65	134.65	0.00	0.00
2001	136.61	135.76	0.85	0.62
2002	138.37	139.14	-0.77	-0.55
2003	140.26	140.62	-0.36	-0.26
2004	142.06	156.10	-14.05	-9.00
2005	143.95	173.51	-29.56	-17.04
Average Errors			0.20	
Average Errors (Absolute Value)			8.34	
Average Differences by percentage (Absolute Value)				6.30

Appendix C: Detailed processes of projections of health expenditures

Table C-1. The Projections of total health expenditures based on Canadian Ea

Table C-1. Projections of total health expenditures based on Canadian Ea

	Age Grou	Estimated Ea based on Canadian Ea, Yuan	Population	Percentage*Estimated China's Ea	Real Total health Expenditure, Billions (1995 Price)
2005	<1	619.0432257	17164963	10625854367	
	1--4	97.59553722	65010051	6344690804	
	5--14	91.54617881	197005329	18035085074	
	15-44	130.9954698	663266701	86884933092	
	45-64	205.9117521	264580304	54480193968	
	65-74	510.2715572	65913894	33633985331	
	75-84	902.9426525	28282368	25537356381	
	85+	1764.392312	5090202	8981113275	
	Total		1306313812	2.44523E+11	
	Estimated Total HEXP				244.5232123
2010	Age Grou	Estimated Ea based on Canadian Ea, Yuan	Population	Percentage*Estimated China's Ea	Real Total health Expenditure, Billions (1995 Price)
	<1	619.0432257	19216255	11895692779	
	1--4	97.59553722	69068688	6740795664	
	5--14	91.54617881	175481263	16064639080	
	15-44	130.9954698	658980442	86323452581	
	45-64	205.9117521	313534777	64560495276	
	65-74	510.2715572	70458908	35953176702	
	75-84	902.9426525	34128429	30816014207	
	85+	1764.392312	6694736	11812140728	
	Total		1347563498	2.64166E+11	
	Estimated Total HEXP				264.166407
2015	Age Grou	Estimated Ea based on Canadian Ea, Yuan	Population	Percentage*Estimated China's Ea	Real Total health Expenditure, Billions (1995 Price)
	<1	619.0432257	19270960	11929557446	
	1--4	97.59553722	76682517	7483871410	
	5--14	91.54617881	169587127	15525053452	
	15-44	130.9954698	624978534	81869356669	
	45-64	205.9117521	370070135	76201789897	
	65-74	510.2715572	84700579	43220296340	
	75-84	902.9426525	39256602	35446460338	
	85+	1764.392312	8870779	15651534268	
	Total		1393417233	2.87328E+11	
	Estimated Total HEXP				287.3279198
2020	Age Grou	Estimated Ea based on Canadian Ea, Yuan	Population	Percentage*Estimated China's Ea	Real Total health Expenditure, Billions (1995 Price)
	<1	619.0432257	17552637	10865840816	
	1--4	97.59553722	73334366	7157106880	
	5--14	91.54617881	183517565	16800331820	
	15-44	130.9954698	586626319	76845390247	
	45-64	205.9117521	399899200	82343944935	
	65-74	510.2715572	113837922	58088253725	
	75-84	902.9426525	43905486	39644135988	
	85+	1764.392312	11859240	20924351880	
	Total		1430532735	3.12669E+11	
	Estimated Total HEXP				312.6693563
2025	Age Grou	Estimated Ea based on Canadian Ea, Yuan	Population	Percentage*Estimated China's Ea	Real Total health Expenditure, Billions (1995 Price)
	<1	619.0432257	15432175	9553183352	
	1--4	97.59553722	65794935	6421292034	
	5--14	91.54617881	186266202	17051959034	
	15-44	130.9954698	578101597	75728690284	
	45-64	205.9117521	408706202	84157410148	
	65-74	510.2715572	128451661	65545229081	
	75-84	902.9426525	55588028	50192801449	
	85+	1764.392312	14783017	26083041541	
	Total		1453123817	3.34734E+11	
	Estimated Total HEXP				334.7336069

Sources: 1. U.S. Census Bureau, 2008
2. CIHI, 2005

Table C-1. Projections of total health expenditures based on Canadian Ea

2030 Age Grou	Estimated Ea based on Canadian Ea, Yuan	Population	Percentage*Estimated China's Ea	Real Total health Expenditure, Billions (1995 Price)
<1	619.0432257	14410667	8920825758	
1--4	97.59553722	58876771	5746110100	
5--14	91.54617881	171674999	15716190155	
15-44	130.9954698	571502135	74864190659	
45-64	205.9117521	405583368	83514381927	
65-74	510.2715572	144464435	73716092205	
75-84	902.9426525	77054802	69576067305	
85+	1764.392312	17960912	31690095046	
Total		1461528089	3.63744E+11	
Estimated Total HEXP				363.7439532

2035 Age Grou	Estimated Ea based on Canadian Ea, Yuan	Population	Percentage*Estimated China's Ea	Real Total health Expenditure, Billions (1995 Price)
<1	619.0432257	14361259	8890240045	
1--4	97.59553722	56637189	5527536895	
5--14	91.54617881	154176412	14114261381	
15-44	130.9954698	539122379	70622589310	
45-64	205.9117521	405771557	83553132254	
65-74	510.2715572	179192125	91436644658	
75-84	902.9426525	87096041	78642730282	
85+	1764.392312	24605288	43413380978	
Total		1460962250	3.96201E+11	
Estimated Total HEXP				396.2005158

2040 Age Grou	Estimated Ea based on Canadian Ea, Yuan	Population	Percentage*Estimated China's Ea	Real Total health Expenditure, Billions (1995 Price)
<1	619.0432257	14604376	9040740280	
1--4	97.59553722	57155309	5578103047	
5--14	91.54617881	144019341	13184420343	
15-44	130.9954698	518996681	67986214046	
45-64	205.9117521	391746383	80665184102	
65-74	510.2715572	190517553	97215688440	
75-84	902.9426525	101744994	91869894761	
85+	1764.392312	35834527	63226163937	
Total		1454619164	4.28766E+11	
Estimated Total HEXP				428.766409

2045 Age Grou	Estimated Ea based on Canadian Ea, Yuan	Population	Percentage*Estimated China's Ea	Real Total health Expenditure, Billions (1995 Price)
<1	619.0432257	14428877	8932098642	
1--4	97.59553722	57907254	5651489550	
5--14	91.54617881	142540442	13049032790	
15-44	130.9954698	500382793	65547879043	
45-64	205.9117521	389483072	80199141768	
65-74	510.2715572	167286729	85361659703	
75-84	902.9426525	128878861	1.1637E+11	
85+	1764.392312	41979685	74068633468	
Total		1442887713	4.4918E+11	
Estimated Total HEXP				449.1801556

2050 Age Grou	Estimated Ea based on Canadian Ea, Yuan	Population	Percentage*Estimated China's Ea	Real Total health Expenditure, Billions (1995 Price)
<1	619.0432257	13671955	8463530939	
1--4	97.59553722	56297186	5494354141	
5--14	91.54617881	143918184	13175159806	
15-44	130.9954698	491390874	64369978389	
45-64	205.9117521	369918925	76170653981	
65-74	510.2715572	156818967	80020258487	
75-84	902.9426525	137441569	1.24102E+11	
85+	1764.392312	54704288	96519825172	
Total		1424161948	4.68316E+11	
Estimated Total HEXP				468.3156158

Sources: 1. U.S. Census Bureau, 2008
2. CIHI, 2005

Table C-2. The Projections of out-of-pocket health expenditures based on the incidences of chronic diseases.

Table C-2. The Projections of out-of-pocket health expenditures based on the incidences of chronic diseases.

Age Grou	Estimated Ea (Out-of-pocket) based on "Chronic Diseases Incidence in two week (‰)", Yuan	Population	Percentage*Estimated China's Ea	Real Out-of-pocket health Expenditure,Billions (1995 Price)
2005				
0-4	5.522458196	82175014	453808079.6	
5-14	8.436659186	197005329	1662066819	
15-24	15.85734108	226476751	3591319087	
25-34	51.47069388	211786917	10900819573	
35-44	103.3635192	225003033	23257105316	
45-54	193.7742087	162697733	31526624472	
55-64	319.6755464	101882571	32569366555	
65+	475.5988876	99286464	47220531827	
Total		1306313812	1.51182E+11	
Estimated Out-of-pocket HEXP				151.1816417

Age Group	Estimated Ea (Out-of-pocket) based on "Chronic Diseases Incidence in two week (‰)", Yuan	Population	Percentage*Estimated China's Ea	Real Out-of-pocket health Expenditure,Billions (1995 Price)
2010				
0-4	5.522458196	88284943	487549907.1	
5-14	8.436659186	175481263	1480475609	
15-24	15.85734108	226079498	3585019711	
25-34	51.47069388	194295308	10000514321	
35-44	103.3635192	238605636	24663118232	
45-54	193.7742087	178871902	34660761272	
55-64	319.6755464	134662875	43048428149	
65+	475.5988876	111282073	52925630123	
Total		1347563498	1.70851E+11	
Estimated Out-of-pocket HEXP				170.8514973

Age Group	Estimated Ea (Out-of-pocket) based on "Chronic Diseases Incidence in two week (‰)", Yuan	Population	Percentage*Estimated China's Ea	Real Out-of-pocket health Expenditure,Billions (1995 Price)
2015				
0-4	5.522458196	95953477	529899065.5	
5-14	8.436659186	169587127	1430748793	
15-24	15.85734108	194825413	3089413025	
25-34	51.47069388	222183992	11435964238	
35-44	103.3635192	207969129	21496421053	
45-54	193.7742087	218660078	42370683592	
55-64	319.6755464	151410057	48402092705	
65+	475.5988876	132827960	63172830012	
Total		1393417233	1.91928E+11	
Estimated Out-of-pocket HEXP				191.9280525

Age Group	Estimated Ea (Out-of-pocket) based on "Chronic Diseases Incidence in two week (‰)", Yuan	Population	Percentage*Estimated China's Ea	Real Out-of-pocket health Expenditure,Billions (1995 Price)
2020				
0-4	5.522458196	90887003	501919674.6	
5-14	8.436659186	183517565	1548275151	
15-24	15.85734108	173515673	2751497209	
25-34	51.47069388	222005550	11426779704	
35-44	103.3635192	191105096	19753295255	
45-54	193.7742087	232194437	44993293298	
55-64	319.6755464	167704763	53611111750	
65+	475.5988876	169602648	80662830715	
Total		1430532735	2.15249E+11	
Estimated Out-of-pocket HEXP				215.2490028

Age Group	Estimated Ea (Out-of-pocket) based on "Chronic Diseases Incidence in two week (‰)", Yuan	Population	Percentage*Estimated China's Ea	Real Out-of-pocket health Expenditure,Billions (1995 Price)
2025				
0-4	5.522458196	81227110	448573319.4	
5-14	8.436659186	186266202	1571464464	
15-24	15.85734108	167845378	2661581408	
25-34	51.47069388	191231339	9842809710	
35-44	103.3635192	219024880	22639182384	
45-54	193.7742087	202657419	39269781007	
55-64	319.6755464	206048783	65868757295	
65+	475.5988876	198822706	94559857794	
Total		1453123817	2.36862E+11	
Estimated Out-of-pocket HEXP				236.8620074

Sources: 1. U.S. Census Bureau, 2008
2. Health Ministry of China, 2004

Table C-2. The Projections of out-of-pocket health expenditures based on the incidences of chronic diseases.

2030 Age Group	Estimated Ea (Out-of-pocket) based on "Chronic Diseases Incidence in two week (‰)", Yuan	Population	Percentage*Estimated China's Ea	Real Out-of-pocket health Expenditure,Billions (1995 Price)
0-4	5.522458196	73287438	404726812.7	
5-14	8.436659186	171674999	1448363457	
15-24	15.85734108	181983772	2885778744	
25-34	51.47069388	170445064	8772925713	
35-44	103.3635192	219073299	22644187142	
45-54	193.7742087	186689300	36175571383	
55-64	319.6755464	218894068	69975080797	
65+	475.5988876	239480149	1.13896E+11	
Total		1461528089	2.56203E+11	
Estimated Out-of-pocket HEXP				256.2031265

2035 Age Group	Estimated Ea (Out-of-pocket) based on "Chronic Diseases Incidence in two week (‰)", Yuan	Population	Percentage*Estimated China's Ea	Real Out-of-pocket health Expenditure,Billions (1995 Price)
0-4	5.522458196	70998448	392085961.1	
5-14	8.436659186	154176412	1300733843	
15-24	15.85734108	184965102	2933054710	
25-34	51.47069388	165282601	8507210160	
35-44	103.3635192	188874676	19522751194	
45-54	193.7742087	214399842	41545159732	
55-64	319.6755464	191371715	61176857563	
65+	475.5988876	290893454	1.38349E+11	
Total		1460962250	2.73726E+11	
Estimated Out-of-pocket HEXP				273.7264563

2040 Age Group	Estimated Ea (Out-of-pocket) based on "Chronic Diseases Incidence in two week (‰)", Yuan	Population	Percentage*Estimated China's Ea	Real Out-of-pocket health Expenditure,Billions (1995 Price)
0-4	5.522458196	71759685	396289860.6	
5-14	8.436659186	144019341	1215042096	
15-24	15.85734108	170659638	2706208088	
25-34	51.47069388	179806721	9254776694	
35-44	103.3635192	168530322	17419887170	
45-54	193.7742087	214533295	41571019482	
55-64	319.6755464	177213088	56650690740	
65+	475.5988876	328097074	1.56043E+11	
Total		1454619164	2.85257E+11	
Estimated Out-of-pocket HEXP				285.2565175

2045 Age Group	Estimated Ea (Out-of-pocket) based on "Chronic Diseases Incidence in two week (‰)", Yuan	Population	Percentage*Estimated China's Ea	Real Out-of-pocket health Expenditure,Billions (1995 Price)
0-4	5.522458196	72336131	399473259.5	
5-14	8.436659186	142540442	1202565129	
15-24	15.85734108	153449853	2433306658	
25-34	51.47069388	183232688	9431113593	
35-44	103.3635192	163700252	16920634137	
45-54	193.7742087	185201710	35887314808	
55-64	319.6755464	204281362	65303756021	
65+	475.5988876	338145275	1.60822E+11	
Total		1442887713	2.924E+11	
Estimated Out-of-pocket HEXP				292.3996802

2050 Age Group	Estimated Ea (Out-of-pocket) based on "Chronic Diseases Incidence in two week (‰)", Yuan	Population	Percentage*Estimated China's Ea	Real Out-of-pocket health Expenditure,Billions (1995 Price)
0-4	5.522458196	69969141	386401656.2	
5-14	8.436659186	143918184	1214188669	
15-24	15.85734108	143557895	2276446506	
25-34	51.47069388	169450057	8721712012	
35-44	103.3635192	178382922	18438286579	
45-54	193.7742087	165448151	32059584544	
55-64	319.6755464	204470774	65364306406	
65+	475.5988876	348964824	1.65967E+11	
Total		1424161948	2.94428E+11	
Estimated Out-of-pocket HEXP				294.4282085

Sources: 1. U.S. Census Bureau, 2008
2. Health Ministry of China, 2004